

THERAPEUTIC LOW LEVEL LASER APPARATUS AND METHOD

This application claims the benefit under 35 U.S.C. § 119(e) of the U.S. provisional patent application no. 60/401,103 filed August 5, 2002.

5 Technical Field

The present invention relates to therapeutic lasers, and more particularly to a method and apparatus for programmable, multi-frequency, multi-wavelength low level laser therapy.

10 Background Art

Any living cell in a biological system requires energy for normal metabolism, function, and repair. When injury or sickness occurs, normal metabolism, function, and repair is impaired. The addition of energy delivered
15 directly to damaged areas can aid in the return of normal function.

United States Patent No. 4,930,504 to Diamantopoulos et al. discloses a therapeutic device with a cluster probe connected to a control box. The cluster probe
20 has laser, superluminous and light emitting diodes that emit steady or selectively pulsed radiation in multiple wavelengths to enhance the depth of delivery of energy within the tissue. United States Patent No. 4,951,663 to L'Esperance, Jr. discloses a sterilization device with two
25 laser beams with the phase shift and polarization angle being adjustable between the beams. L'Esperance, Jr. does not suggest any specific beneficial phase shift or

polarization angle. The "Resonator" and the "Rotary Multiplex", Low Level Lasers, Inc., are therapeutic devices
30 with a combination of laser and light emitting diodes of multiple wavelengths that are pulsed. The "Rotary Multiplex" includes an increasing pulse frequency program and can be factory reprogrammed.

Disclosure of the Invention

35 Therapeutic low level laser apparatus includes a housing, a diode array, control electronics connected to the diode array, and a power source, means for operator input and means for operator output, connected to the control electronics. The diode array has four sets of laser diodes
40 arranged symmetrically about the center of the array, and four pairs of light emitting diodes arranged between the sets of laser diodes. Each set of laser diodes includes first, second and third laser diodes arranged in an equilateral triangle and oriented such that the planes of
45 the linear beams are approximately 120 degrees to each other, intersecting at the center of the triangle. The first, second and third laser diodes emit light of a selected first, second and third wavelength, respectively. The pairs of light emitting diode are arranged in opposed
50 locations about the center of the array and each pair of light emitting diodes emits light of a selected different frequency. The control electronics are programmable and activate the diode array, controlling power output and pulse frequency of each laser and light emitting diode. The
55 therapeutic low level laser method includes providing apparatus that emits a beam of three selected wavelengths of laser light and four selected wavelengths of light emitting

diode light, pulsing the beam pursuant to a selected frequency sequence, and exposing tissue to the beam.

60 **Brief Description of the Drawings**

Details of this invention are described in connection with the accompanying drawings that bear similar reference numerals in which:

Figure 1 is a front elevation view of apparatus
65 embodying features of the present invention.

Figure 2 is a back elevation view of the apparatus of Figure 1.

Figure 3 is a sectional view taken along line 3-3 of Figure 1.

70 Figure 4 is a diagrammatic view of the diode array of the apparatus of Figure 1.

Detailed Description Of The Invention

Referring now to Figures 1 to 3, therapeutic low level laser apparatus embodying features of the present
75 invention includes a housing 11, a diode array 12, control electronics 14, an electric power source 15, a means for operator input 16 and a means for operator output 17. Housing 11 is generally elongated, has a front 20 and a back 21, and is preferably sized and shaped to be comfortably
80 held in the hand of an operator. Other sizes and shapes are suitable for housing 11.

The diode array 12 is substantially planar and is mounted in a recessed manner in the back 21 of the housing

11. The diode array includes four each first, second and
85 third laser diodes 1, 2 and 3, and two each first, second,
third and fourth light emitting diodes 4, 5, 6 and 7 that,
in the illustrated embodiment, emit the following
wavelengths:

- 1 = 650nm laser diode
- 90 2 = 780nm laser diode
- 3 = 808nm laser diode
- 4 = 660nm light emitting diode
- 5 = 880nm light emitting diode
- 6 = 470nm light emitting diode
- 95 7 = 940nm light emitting diode

As shown in Figure 4, the first, second and third
laser diodes 1, 2 and 3 are arranged in four sets 23, with
one set 23 at each of 45, 135, 225, and 315 degrees about
the center 24 of the diode array 12. Each set 23 is arranged
100 as an equilateral triangle with the first laser diodes 1
each an equal first distance from center 24 and the second
and third laser diodes 2 and 3 an equal greater second
distance from center 24. The first, second and third laser
diodes 1, 2 and 3 of each set 23 are oriented at 120 degrees
105 to each other, as indicated by the lines through the first,
second and third laser diodes 1, 2 and 3 in Figure 4, with
the first laser diodes 1 being oriented along lines through
center 24. The first, second, third and fourth light
emitting diodes 4, 5, 6 and 7 are arranged in a cross
110 formation between the sets 23 with equal wavelengths being
mirrored or opposed across center 24.

Referring again to Figures 1 to 3, the control
electronics 14 and power source 15 mount in the housing 11
with the power source 15 connecting to and powering the
115 control electronics 14. The power source 15 is preferably a

rechargeable storage battery and is preferably rechargeable without removal from the housing 11. The control electronics 14 connect to and provide electric power to diode array 12 to individually activate and control the intensity of each
120 of the first, second and third laser diodes 1, 2 and 3, and each of the first, second, third and fourth light emitting diodes 4, 5, 6 and 7. The control electronics 14 include current monitoring to assure precise intensity control. The control electronics 14 can pulse each of the first, second
125 and third laser diodes 1, 2 and 3, and each of the first, second, third and fourth light emitting diodes 4, 5, 6 and 7 at a frequency of from about 0.1Hz to 300kHz in 0.01Hz increments.

The control electronics 14 is programmable and, in
130 the illustrated embodiment, includes three preprogrammed modes:

Mode 1: Frequency = 50Hz, duration = 3 minutes, power = all lasers set at 1 to 4 mW.

Mode 2: Frequency = 7.83Hz, duration = 3 minutes, power =
135 all lasers set at 1 to 4 mW.

Mode 3: Frequency = see below, total duration = 3 minutes, power = all lasers set at 1 to 4 mW.

1. 17.16 sec - 4.3 Hz
2. 5.72 sec each for 28 increments that increase from 4.7 Hz
140 to 130.2 Hz.

The means for operator input 16 is connected to the control electronics 14 and in the illustrated embodiment includes an on/off button 27, a function button 28 and a mode button 29. Other means for operator input 16 are

145 suitable, such as additional buttons, a keypad, or a jack
for connection to a keyboard or a personal computer.

The means for operator input 16 also includes a
jack 30 for connection of a calibration device that allows
the manufacturer to calibrate the diode array 12 and to
150 download operation modes such as listed above. The jack 30
may also be used by an operator to download new modes. By
way of example, and not as a limitation, the calibration
device may be a personal computer. The means for operator
output 17 is mounted on the front 20 of housing 11,
155 connected to the control electronics 14 and, in the
illustrated embodiment, includes a mode indicator 32, a
battery indicator 33 and a time remaining indicator 34.

The first, second and third laser diodes 1, 2 and
3, and the first, second, third and fourth light emitting
160 diodes 4, 5, 6 and 7 emit beams normal to the plane of the
diode array 12. The configuration of the diode array 12
provides four "hot spots" where the beams of the first,
second and third laser diodes 1, 2 and 3 overlap. Due to the
"Soliton Phenomenon", where multiple overlapping waveforms
165 create unique wave structures capable of imparting effects
unattainable with individual waveforms, improved penetration
into tissue is provided.

The method of the present invention includes the
steps of: providing a diode array with sets of first, second
170 and third laser diodes that emit at wavelengths of about
650nm, 780nm and 808nm, respectively, with the beams of the
first, second and third laser diodes oriented at about 120
degrees relative to each other and overlapping, pulsing the
first, second and third laser diodes at a selected frequency

175 sequence and projecting the resultant beam on the tissue.
The first, second and third laser diodes may be pulsed
according to the above described modes as well other modes.

Although the present invention has been described
with a certain degree of particularity, it is understood
180 that the present disclosure has been made by way of example
and that changes in details of structure may be made without
departing from the spirit thereof.